THE EFFECT OF MEDIA ON PRESERVICE SCIENCE TEACHERS' ATTITUDES TOWARD ASTRONOMY AND ACHIEVEMENT IN ASTRONOMY CLASS

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ABSTRACT
Studies show that it is hard to change students' attitudes toward science. This study specifically explored if media affect preservice science teachers' attitudes toward astronomy and their astronomy achievement. The sample for the pilot study consisted of 196 preservice science and mathematics teachers for attitude assessment and 230 preservice science and mathematics teachers for achievement test. The participants of the main study were 88 preservice science teachers for attitude assessment and 82 preservice science teachers for achievement test. Survey of Attitudes toward Astronomy was used for attitudes assessment. In addition, the researcher developed the Astronomy Concept Test (AstroCoT) to test preservice science teachers' astronomy achievement. Pre-post design was used in the current study. The results showed no significant differences between groups for attitudes and achievement. There were no means effects of media on preservice science teachers' attitudes toward astronomy and achievement in astronomy class. However, preservice science teachers' attitudes toward astronomy and achievement in astronomy both improved significantly within each group (with or without media). Even though media was not apparently the reason for the significant changes, it is notable that the preservice science teachers did develop positive attitudes toward astronomy and also increased their achievement in astronomy.

INTRODUCTION

Astronomy has always attracted the attention of human beings throughout history. Many objects in the sky, like stars and planets, have regularly been observed by human beings. In particular, ancient people were interested in the motion of the moon and the sun. People did agriculture based on the motion of the objects in the sky such as the moon, the sun, and other stars. Today, scientists have much more information about astronomy, but still they have a lot to discover about the universe. Even though astronomy is very old, it is quite a new course for Turkish preservice science teachers. Preservice science teachers in Turkey first are exposed to astronomy during the very last semester of their teacher training program. Therefore most Turkish preservice science teachers are naïve learners of astronomy.

Students' attitudes toward science may vary when they are naïve learners. Therefore, in the current study attitude toward astronomy is considered as attitude toward a new science course. Turkish preservice science teachers' astronomy knowledge is limited to what they have learned in previous science classes like physics or earth science. However, most of the astronomy content does not match with previous science classes that students have taken. Therefore, astronomy seems to be a quite different science course for these students.

Astronomy education plays an important role in the development of scientific literacy as well as the development of critical-thinking skills and science process skills (Ucar & Demircioglu, 2011). Therefore astronomy education might be important for students to develop positive attitudes toward science. Students are experiencing astronomy every day by observing the motion of the moon, the planets, the sun, and other stars. It is important to interpret these motions based on scientific laws since interpretation of those motions may improve scientific thinking skills.

Kind, Jones, & Barmby (2007) noted that the main problem with attitude studies comes from understanding the definition of *attitude* itself. The most common definition of attitudes involves the following factors: cognition, affect and behavior (Bagozzi & Burnkrant, 1979; Bloom, 1976; Kind et al., 2007; McGuire, 1985; Reid, 2006). According to Reid, the cognitive component is related to knowledge and beliefs, the affective component is about feeling, and the behavioral component regards the tendency toward an action. Kind, et al. (p.873) defined attitude as *"the feelings that a person has about an object, based on their beliefs about that object"*

Attitudes toward Science and Astronomy

There are many studies related to students' attitudes toward science and specifically the physical sciences. The main concern for conducting much of the research related to science attitudes was to find out possible answers for the decreasing number of students that prefer to study science (Kind, et al., 2007; Osborne, Simon & Collins, 2003; Reid, 2006). Durrani (1998) reported that the percentage of 18-year-old students who preferred taking science and mathematics at A-level, decreased dramatically in the 30 years from 1963 to 1993 from 42% to 16%. It is clear that over this time period students had developed negative attitudes toward science and mathematics.

Therefore it is very crucial to take some precautions to guard against this decreasing number of students who prefer to study science. If students develop positive attitudes toward science, it is more likely that they will prefer to study science in the future.

The studies related to attitudes toward science showed different results. George (2000) and Piburn and Baker (1993) noted that students' attitudes toward science decline as they grow older. On the contrary, Ucar and Demircioglu (2011) reported that even a semester-long astronomy course did not change students' attitudes toward astronomy; the four year teacher training program positively changed preservice science teachers' attitudes toward astronomy. On the other hand, Reid and Skryabina (2002) observed attitudes toward science do not necessarily decline as school pupils grow older. Similarly, Brossand, Levenstein, and Bonney (2005) and Reid and Skryabina found that media events or science festivals do not affect students' attitudes toward science. As can be seen, the research reports about attitudes toward science vary. That seems to be reasonable because there are many factors that may affect students' attitudes toward science. Some of these factors that were reported in the previous studies are syllabus (Skryabina, 2000), instruction technique, and teacher (George, 2000; Osborne et al., 2003; Reid & Skryabina, 2002), parents (George, 2000; Keeves, 1975; Osborne et al., 2003; Reid & Skryabina, 2002), friends (George, 2000; Keeves, 1975; Osborne et al., 2003; Simpson & Troost, 1982), and the attitude instrument itself (Reid, 2006). Gardner (1995) declared that scientific attitude is a complex multidimensional construct however it is usually considered as a one-dimensional construct. Based on the literature, attitude seems to be a complex factor to be measured and as Gardner stated it should not be reduced to one simple factor.

Learning through Media

What we know about astronomy changes rapidly. Pluto had been accepted as a planet in 1930. However, when Eres an object similar to Pluto was discovered in the Kuiper Belt in 2005 the discussion for the definition of a planet had started. The International Astronomical Union (IAU) decided to categorize Pluto and Eris as *dwarf planets* in 2006. As a result, our solar system now has eight planets instead of nine. It might be hard to accept that initially, however it is a scientific fact. Students usually hear that kind of scientific changes through media and it takes some time for those changes to take place in textbooks. During this transition students are usually confused and this may affect their attitudes toward science, because they began to start thinking that what they learn in science class may not be true like in the case of Pluto. In conclusion, even today we may know or learn some scientific events as true and they may change in the future. For example, astronomers are still trying to understand the universe. Therefore they built larger telescopes to gather more accurate data to reach better scientific conclusions as technology develops.

Media are one of the most common tools that are used to communicate knowledge. Students frequently face astronomy through news, magazines, books or documentaries. It is important that the source of the media itself to be well-known and trusted (Cakmakci & Yalaki, 2012). Therefore the media used in the current study was selected based on those criteria. One of the types of media, video (documentary) was primarily used in the current study. There are many videos available on the Internet and they are widely used in preservice teacher education (Ozkan, 2002). The main concern about video-based instruction is the learner is usually not active in the learning process. Choi and Johnson (2010) reported that many studies related to video-based instruction were not effective due to passive learners. However, Choi and Johnson said in a few studies students were actively engaged in video-based instruction. Similarly, Jonassen, Campbell, and Davidson (1994) argued that students learn from thinking but not directly from media. Jonassen et al. argued that media were not directly responsible for learning, but it might be a tool for effective learning. "*Media are not responsible for learning; learners are*" (Jonassen, et al., p.38).

Instruction technique may affect students' attitudes toward science (George, 2000; Osborne, et al. 2003; Reid & Skryabina, 2002). Teachers usually prefer to use media for supporting their instruction. Moreover, Kahveci (2010) concluded that students develop positive attitudes toward the use of technology and they commonly use technology one way or another for their learning. Astronomy documentary films are one type of media that may attract students' attention since they are supposed to be naïve learners of astronomy. Videos are audio visual presentations that may help students to develop positive attitudes toward astronomy. In addition to videos, newspapers and science magazines help students to learn about new scientific developments.

Pena and Gil Quilez (2001) reported that neither images that illustrate phases of the moon nor a text explanation that describes phases of the moon was sufficient for learning when they were presented independently. This explanation was consistent with dual coding theory, which was introduced by Paivio (1990). According to dual coding theory visual and verbal processes take place in different parts of the brain and if they are presented

together it can facilitate learning. In the case of video-based instruction, it seems important to support the videos with some appropriate instruction and discussions.

THE RESEARCH AIM AND SIGNIFICANCE OF THE STUDY

Several studies have been conducted related to astronomy education. Most of these studies were related to conceptual understanding of astronomy (Bisard, Aron, Francek & Nelson, 1994; Lightman & Sadler, 1993; Trumper, 2006; Zeilik, Schau & Mattern, 1998). The research about attitude changes toward astronomy is quite limited to a few studies (Jarman & Mc Aleese, 1996; Kallery, 2001; Ucar & Demircioglu, 2011; Wittman, 2009). In addition, Schibeci (1984) noted that developing positive attitudes toward science plays an important role in students' achievement. Moreover, Osborne et al. (2003) said that students' attitudes toward science have been studied extensively for the last several years. However, there was a lack of research on how media affects students' attitudes toward astronomy and their achievement in astronomy class. It is very important for students to develop positive attitudes toward science since the number of students who prefer to study science decreased dramatically in the last several years. The current study aimed to determine if media affects students' attitudes toward astronomy and their astronomy achievement. Therefore, the following research questions were addressed in this study:

1. How does preservice science teacher attitude toward astronomy differ between groups who were exposed and not exposed to media?
2. How does preservice science teacher astronomy achievement differ between groups who were exposed and not exposed to media?

METHODOLOGY

Participants

The data was collected from one of the largest universities in Turkey. The sample for the pilot study of attitude assessment data was 196 students (135 preservice science and 61 preservice mathematics teachers). In the main study, the attitude assessment instrument was applied to 88 preservice science teachers taking astronomy for the first time. On the other hand, the sample for the achievement test for the pilot study was 230 preservice science and mathematics teachers (187 preservice science and 43 preservice mathematics teachers). In the main study, the achievement test was applied to 82 preservice science teachers taking astronomy for the first time.

Turkish preservice science teachers first encountered astronomy content during the last semester of their four-year teacher training program. Astronomy for preservice science teachers is a two credit science course. The astronomy course became a part of the new curriculum in 2006. The course is offered during the fourth year of the teacher training program. Therefore, Turkish preservice science teachers have first been exposed to astronomy in the class of 2010.

Instruments and Research Design

Survey of Attitudes Toward Astronomy (Zeilik, Schau, & Mattern, 1999) was used to collect data. The original instrument is available at http://www.flaguide.org/tools/attitude/astpr.php. The instrument was first translated from English to Turkish by three colleagues who had their PhD's from American Universities. Then, after one week, the Turkish version of the instrument was given to the same colleagues to be translated from Turkish to English. These translations were compared for consistency and some corrections were made. The next step was to administer the English version of the test to 93 academic persons whose second language was English. The Turkish version of the test was administered, after one week, to the same group. The correlation between participants' answers was found to be 0.81. The result shows that the participants understood the same meaning from the English and Turkish versions of the instrument. As a result, the translation was deemed to be valid. For the attitude survey, the responses were coded numerically as "Strongly agree"=5, "Agree"=4, "Neither agree nor disagree"=3, "Disagree"=2, and "Strongly disagree"=1. Student responses were reverse-coded for negative items before reliability analysis of the data. After validation of the translation of the instrument, a pilot study with 196 preservice teachers (135 preservice science and 61 preservice elementary mathematics teachers) was conducted. The reliability for the Turkish version was 0.88 for 34 items. Based on the statistical analysis, 5 items were eliminated and the resulting reliability increased to 0.90 for the remained 29 items. The final version of the instrument with 29 items was applied to 88 preservice science teachers during their last semester of the teacher training program.

The groups were not assigned randomly, because the students in the two groups had been assigned to the classes based on the alphabetical order of their last names. The participants had individual differences like GPA and they may have had different levels of interest in the media. Since some variables like GPA or interest in the media could not be controlled, the research design of this study was quasi-experimental. None of the participants had an astronomy course before. The experimental group consisted of 43 preservice science teachers and the

control group consisted of 45 preservice science teachers who were at their last year of teacher training program. Participants had been given the Turkish version of the Astronomy Attitude assessment with 29 items at the beginning of the semester. The post assessment was given to both groups after instruction at the end of the semester. The control group was taught astronomy by using traditional lecture in which the teacher was more active and students were relatively less active in the classroom. The teacher asked questions and the students gave answers or vice versa. In the experimental group, the instruction was supported by trusted media related to astronomy namely videos (documentaries), news, and magazines. Students in that group were informed about some daily news like sun storm. In addition, students watched and discussed some videos (e.g. shuttle launch video from NASA website). The documentaries (videos) are used heavily compared to news and magazines. The trusted media was selected based on the source of the media. For example, documentaries were selected based on the name of the publisher (e.g. NASA).

Astronomy Concept Test (AstroCoT) was developed by the author to test preservice science teachers' achievement of basic astronomy concepts. The test was formed based on the journals of 73 former preservice science teachers in 2010 astronomy class. Two astronomy experts checked the items for the purpose of the content validity. The instrument with 26 multiple-choice items was applied to 230 preservice science and mathematics teachers (187 preservice science and 43 preservice mathematics teachers) in the pilot study. After the data analysis of the pilot study, 8 items were eliminated and the final version of the test with 18 multiple-choice questions was applied to 82 preservice science teachers who were at their last year of teacher training program. The chance factor in a test affects the reliability and validity of the test (Baykul, 2000). All the participants were taking astronomy for the first time, so it was reasonable to expect them to guess. In fact, in their study Zeilik et al. (1997) calculated the Cronbach alpha value 0.43 on the pretest and 0.67 on the posttest. Zeilik et al said that since students are novices when they take a new course the internal consistency can be low. Therefore, for each question students were asked to decide if they were sure or not sure of their responses. The main purpose for doing that was to find out if participants really knew the answer of a specific question or if they just guessed. Based on the analysis of the pretest, initially the Cronbach alpha value was 0.49. However, the data were recoded to find out if students who guessed were changing the reliability or not. Students that responded correctly were originally coded as 1. However the participants' scores were re-coded as 0 if they were not sure of their answers. That is to say, if a participant selected the correct answer but was not sure of her/his answer that was interpreted to mean that the participant got the correct answer by chance. After recoding the data, the Cronbach alpha value increased to 0.71. Based on that result, it was obvious that many students guessed when they responded. The final version of AstroCoT was administered at the beginning and at the end of the semester.

Data Analysis

Quantitative data analysis was carried by using SPSS 16.0 statistical software package. T-statistics has been computed to determine if there was a significant difference in the changes of preservice science teachers' attitudes toward astronomy between the experimental and the control groups. In addition, the paired sample t-test was used to see if there were significant changes in students' attitudes toward astronomy within each group. Similarly, an independent sample t-test was used to search for any significant effect of media on astronomy achievement between two groups. Finally, another paired sample t-test was computed to search for any significant changes of students' astronomy achievement within control and experimental groups independently.

RESULTS

The results of the study are presented in two parts. The first part consists of the results related to the attitude assessment. In this part, the relationship between media and preservice science teachers' attitudes toward astronomy is presented first; then the change in astronomy attitudes is presented within each group. The second part presents the results related to the achievement test. In this part, the relationship between media and achievement is presented first; then the change in astronomy achievement is presented for each group independently.

Attitude Assessment

The mean for the pre-assessment of attitudes for students who were exposed to media was 114.44 and for those not exposed to media the mean was 112.35. As seen in Table 1, the difference between these two groups was not statistically significant. Similarly the mean for the post-assessment of attitudes for students who were exposed to media was 122.68 and for those not exposed the mean was 120.48. Therefore, the mean difference between control and experimental group was not statistically significant. Based on the results of the attitude assessment, it was found that media had no significant effect on preservice science teachers' attitudes toward astronomy (see Table 1). One participant in the experimental group who took the pre-assessment did not take the post-assessment, so the number of participants (N) in control group decreased from 45 to 44. Similarly, one

participant in control group who took the pre-assessment and did not take the post-assessment and the number of participants (N) in experimental group decreased from 43 (pre-assessment) to 42 (post-assessment).

Table 1: Pre-assessment and post-assessment results of t statistics between groups for effect of media on attitudes toward astronomy

Test	Group	N	Mean	Std. dev.	T statistics
Pre-assessment	Experimental	45	114.44	10.71	0.89
	Control	43	112.35	11.41	
Post-assessment	Experimental	44	122.68	9.36	1.04
	Control	42	120.48	10.35	

$p \geq 0.05$

The attitude mean score for media group was 114.23 on the pre-assessment and 122.68 on post-assessment (see Table 2). The difference between mean values was statistically significant ($p<0.05$). In the same way, the mean for non-media group was 112.31 on pre-assessment and 120.48 on post-assessment. The difference between pre- and post-assessment means was statistically significant ($p<0.05$). The data analysis within each group showed significant results for both groups. This means that students developed positive attitudes toward astronomy, however this was not necessarily because of media. Several factors like instructor or student interest may have affected students' development of positive attitudes toward astronomy. In addition, students' experiences of using media and GPA might be other possible reasons.

Table 2: Results of t statistics for attitudes toward astronomy of experimental and control groups

Group	Test	N	Mean	Std. dev.	t	p
Experimental	Pre-assessment	44	114.23	10.74	5.49*	0.000
	Post-assessment	44	122.68	9.35		
Control	Pre-assessment	42	112.31	11.54	5.98*	0.000
	Post-assessment	42	120.48	10.35		

*$p<0.05$

Achievement Test

The mean of students' astronomy achievement was 6.10 for media group and 6.81 for non-media group on pretest. As seen in Table 3, the difference between mean values was not statistically significant. Moreover, students' astronomy achievement mean was 10.62 for media group and 10.76 for non-media group on posttest. Therefore, the mean difference between control and experimental group was not statistically significant. Based on the results of the achievement test it was found that media had no significant effect on preservice science teachers' astronomy achievement (see Table 3). One participant in control group took the pretest however that participant did not take the posttest; this is why the number of participants (N) in control group was 42 on pretest and 41 on posttest.

Table 3: Pretest results of t statistics between groups for effect of media on astronomy achievement

Test	Group	N	Mean	Std. dev.	T statistics
Pretest	Experimental	40	6.10	2.58	-1.30
	Control	42	6.81	2.36	
Posttest	Experimental	40	10.62	2.51	-0.25
	Control	41	10.76	2.13	

$p \geq 0.05$

The achievement mean for media group was 6.10 on pretest and 10.62 on posttest. The difference between mean values was statistically significant ($p<0.05$). In the same way, the mean for non-media group was 6.88 on pretest and 10.76 on posttest. The difference between pre and posttest means was statistically significant ($p<0.05$). The data analysis within each group showed significant results for both groups (see Table 4). Student achievement was significantly increased within both media and non-media groups. This change was not necessarily related to use of media. Some other factors like realizing misconceptions or students' interest may have affected students' astronomy achievement.

Table 4: Results of t statistics for astronomy achievement of experimental and control groups

Group	Test	N	Mean	Std. dev.	t	p
Experimental	Pretest	40	6.10	2.58	-12.05*	0.000
	Posttest	40	10.62	2.51		
Control	Pretest	41	6.88	2.35	-11.32*	0.000
	Posttest	41	10.76	2.13		

*p<0.05

CONCLUSION AND IMPLICATIONS

The first aim of the current study was to search for the effect of media on preservice science teachers' attitudes toward astronomy. The results of the current study showed that use of media did not have any significant effect on students' attitudes toward astronomy. The participants of this study had an astronomy course for the first the time in their lives. Therefore, at the beginning of the course they lacked many basic astronomy concepts and they had many astronomy misconceptions. However, all students were quite interested in the astronomy class. In fact, the more they learned the more they were interested in the course. Students' attitudes toward astronomy changed within each group. One of the reasons for that might be students' poor prior knowledge of astronomy and the increase in their interest of astronomy as the course developed.

The second aim of this study was to search for the effect of media on preservice science teachers' achievement in astronomy class. Based on the results no significant effect was found between media and preservice science teachers' achievement in astronomy class. However, students' achievement changed significantly within each group. It is obvious that students learned a great deal of astronomy, but not necessarily due to media.

Several factors may have affected students' attitudes toward astronomy and achievement in astronomy class. Based on the AstroCoT pretest results it was clear that students' astronomy knowledge when they come to class was quite limited. Therefore students learned many concepts during astronomy class and that may have improved their attitudes toward astronomy and achievement in astronomy class. The instructor might be another reason for the change on students' attitudes and achievement. The instructor always questioned students to find out what they already knew about astronomy topics and encouraged students to make comments about each topic. Moreover, GPA or experience of using media might be other reasons for the change on students' attitudes and achievement. The actual reasons for the change in students' attitudes and achievement need further research.

Attitudes are hard to change once they are formed (Ajzen & Fishbern, 1980). Therefore it is very important to develop positive attitudes toward astronomy for preservice science teachers. If teachers have positive attitudes toward astronomy then they may help their students' to develop positive attitudes toward astronomy. The previous research about attitudes toward astronomy showed different results. The results from Ucar and Demircioglu (2011) showed no significant result for attitude change for one semester-long astronomy class. In the current study, preservice science teachers developed positive attitudes toward astronomy within each group in one-semester long astronomy course. The participants of this study liked astronomy and they will probably have more interest in this topic when they begin to teach. However, it was noticeable to find out that media did not have any significant effect on students' attitudes toward astronomy.

One of the disadvantages of learning through media is that students are not active in the learning process (Choi & Johnson, 2010). In fact, Jonassen, et al. (1994) stated that media cannot be directly related to learning process, but it might be an important tool for an effective learning. The main point here is that students need to think for effective learning process. Therefore media need to be presented along with some explanations or discussions. As in Paivio's (1990) dual coding theory visual and verbal tools need to be presented together for better learning. In the current study, media was supported with some explanations and classroom discussions.

The number of students who prefer to study science is decreasing dramatically (Durrani, 1998). Based on Durrani's conclusion it seems that students do not develop positive attitudes toward science. Therefore, the result of this study was important since students developed positive attitudes toward astronomy within each group. Similarly, Kind, et al. (2007) noted that developing positive attitudes plays an important role on students' achievement. The current study showed that students' achievement increased after instruction within each group. Even though there was no significant result between groups it was noticeable to find significant results within each group. Attitudes are hard to change, however the results of this study showed that students' attitudes toward astronomy can change significantly even after a semester long astronomy class.

As Gardner (1995) stated, attitude is very complex and it consists of more than one factor. Cognitive, affective, and behavioral components were presented in the definition of attitude (Bagozzi & Burnkrant, 1979; Bloom,

1976; Kind etal., 2007; McGuire, 1985; Reid, 2006). The cognitive component is related to knowledge and beliefs. The results of this study showed that student achievement within each group was increased significantly. That probably affected student development of positive attitudes toward astronomy. Students were naïve learners of astronomy, so they likely had many misconceptions along with some nonscientific beliefs. The affective component is related to feelings. In the current study, students developed positive feelings toward astronomy. At the beginning of the course the students did not have positive feelings about astronomy since they had quite limited knowledge of astronomy. However, they began to develop positive feelings as the course developed. The behavioral component was probably changed when students began to observe the sky. Students learned how to locate specific stars, planets, and constellations. Therefore the sky began to be more meaningful for them as they learned astronomy.

Astronomy education began to take place in the Turkish science education program in 2010. It is important to prepare future science teachers that have a good knowledge and skills of astronomy. Moreover, it is essential to help preservice science teachers develop positive attitudes toward science and astronomy in specific. If teachers have positive attitudes toward astronomy it might help their students to develop positive attitudes toward science. As many research studies have concluded, the number of students who prefer to study science has been decreasing every year (Durrani, 1998; Kind, Jones, & Barmby, 2007; Osborne, Simon & Collins, 2003; Reid, 2006). If students develop positive attitudes toward science they might be more likely to prefer studying science in the future.

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